UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte RICHARD SPITZ, HELGA UEBBING, DOERTE EIMERS-KLOSE, FRANZ LAERMER, and ANDREA SCHILP

Appeal No. 2005-2707
Application No. 09/720,720

ON BRIEF

Before GARRIS, OWENS, and TIMM, *Administrative Patent Judges.*
TIMM, *Administrative Patent Judge.*

DECISION ON APPEAL

Claims 16-25 and 27-35 are pending in the application. This appeal involves claims 31, 33, and 35, the claims which remain rejected by the Examiner. Claims 16-25, 27-30, 32, and 34 are not currently rejected and, therefore, are not involved in this appeal. We have jurisdiction over the appeal pursuant to 35 U.S.C. § 134.

INTRODUCTION

The claims are directed to a method for etching a silicon element. The method includes a first heat treatment, which takes place before etching, and a second heat treatment, which takes place after etching. Both heating steps are conducted in a vacuum environment. Claim 31 is illustrative:

> Claim 31. A method for etching, comprising:
>
> exposing a silicon element to a first heat treatment in a vacuum at a first elevated temperature;
>
> selectively etching the silicon element with a gaseous etching medium and forming gaseous reactive products, wherein the gaseous etching medium comprises chlorine trifluoride; and
>
> exposing, subsequent to the selective etching, the silicon element to a second heat treatment in a vacuum at a second elevated temperature.

The Examiner maintains two rejections, both of which are maintained under 35 U.S.C. § 103(a). As evidence of unpatentability, the Examiner relies upon the following U.S. Patents:

Takenaka et al. (Takenaka)	US 6,077,451	Jun. 20, 2000
Farnworth et al. (Farnworth)	US 6,136,137	Oct. 24, 2000
Lee et al. (Lee)	US 6,211,010 B1	Apr. 3, 2001 (filed Dec. 1, 1999)
Choi et al. (Choi)	US 6,432,838 B1	Aug. 13, 2002 (eff. filed Oct. 29, 1998)

To reject claims 31 and 33, the Examiner relies upon Lee in view of Takenaka and Choi. To reject claim 35, the Examiner further adds Farnworth.

Appellants state that "[f]or each ground of rejection discussed in this Brief, all claims do not stand or fall together." (Brief, p. 7). Appellants further state that claims 31 and 33 will be argued separately (Id.). Separate arguments for each of these two claims are present (Brief, p. 8-15). We, therefore, consider claims 31 and 33 separately. Because claim 35 is subject to a separate rejection, it is also considered separately.

Based on our review of the issues as presented in the Brief and Answer, we conclude that the totality of the evidence supports the Examiner's conclusion of obviousness with regard to the subject matter of claims 31 and 35. We, however, conclude that the Examiner failed to establish a prima facie case of obviousness with respect to the subject matter of claim 33. We, therefore, affirm-in-part. Our reasons follow.

OPINION

We turn first to the rejection of claim 31 over Lee, Takenaka and Choi. Claim 31 requires a first heat treatment, a selective etching step, and a second heat treatment. The Examiner has established, without dispute by Appellants, that Lee discloses selectively etching as claimed.[1] The Examiner also finds that Lee discloses a heat

[1]The Examiner relied upon Takenaka as evidence that gaseous reactive by-products are inherently formed in the selective etching step of Lee (Answer, p. 3). Appellants do not dispute this finding.

treatment step in accordance with the second heat treatment step of claim 31 (Answer, p. 3). The Examiner acknowledges that Lee does not disclose a heat treatment step in accordance with the first heat treatment step of claim 31, but finds that Choi discloses such a first heat treatment (Answer, p. 4). Based on this evidence, the Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time of the invention to heat the silicon element of Lee before etching, as taught by Choi, because it will, as taught by Choi, help to control the etch rate (Answer, p. 4). The Examiner has found all the limitations of the claimed process within the prior art and further found a reason or suggestion to make the combination and this reason is expressly taught in the prior art. We, therefore, conclude that the Examiner has established a prima facie case of obviousness with respect to the subject matter of claim 31.

The Examiner having established a prima facie case of obviousness, we turn to the arguments of Appellants. *See In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992)("[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a prima facie case of unpatentability. If that burden is met, the burden of coming forward with evidence or argument shifts to the applicant.").

Appellants call into question the Examiner's findings with regard to Lee and Choi. Namely, while the Examiner interprets Lee and Choi as describing heat treatments in a

vacuum environment, according to Appellants, neither reference describes applying a vacuum during heat treating. So the question raised is: Does a preponderance of the evidence support the Examiner's findings with regard to the presence of a vacuum environment during heating in the processes of Lee and Choi? In considering this question it must be kept in mind that "[a] prior art reference must be 'considered together with the knowledge of one of ordinary skill in the pertinent art.'" *In re Paulsen*, 30 F.3d 1475, 1480, 31 USPQ2d 1671, 1675 (Fed. Cir. 1994)(*citing In re Samour*, 571 F.2d 559, 562, 197 USPQ 1, 3-4 (CCPA 1978)). Moreover, as persons of scientific competence in the fields in which they work, examiners are responsible for making findings, informed by their scientific knowledge, as to the meaning of prior art references to persons of ordinary skill in the art and the motivation those references would provide to such persons. *In re Berg*, 320 F.3d 1310, 1315, 65 USPQ2d 2003 (Fed. Cir. 2003). Appellants must show that there is a clear flaw in Examiner's findings such that the findings are not supported by a preponderance of the evidence. *Id.*

Appellants' alternative interpretations of Lee and Choi do not convince us that the Examiner's interpretations are unreasonable or unsupported. That there is support for the Examiner's interpretation becomes clear when one considers the teachings of the references in view of what was known in the prior art.

We first turn to Lee and view this reference in view of what was known in the prior art. Lee is directed to the improvement of a known process of forming a

hemispherical grain (HSG) on silicon (Lee, col. 1, ll. 8-9). In the known process, polysilicon is seeded using Si_2H_6 (Lee, col. 2, ll. 11-13). The flow rate of the Si_2H_6 gas is ramped up during a ventilation step and maintained during seed formation as shown in Figure 3 (Lee, col. 2, ll. 13-20). After formation of the seeded layer, the polysilicon nuclei are transformed into HSGs by heat treatment (*Id.*). Figure 3 shows that the Si_2H_6 gas is removed as heat treatment begins (*Id.*). In the prior art process, an ex-situ wet etching step was conducted in order to clean the wafer before the HSG formation (Lee, col. 1, ll. 36-38). According to Lee, the prior art process experiences a severe problem of native oxide formation when the wafer is exposed to air for more than ten minutes between the ex-situ pre-cleaning of the wafer and the loading of the wafer into the HSG growth reactor (Lee, col. 2, ll. 21-2). To prevent native oxide formation, Lee performs an etching step within the HSG chamber (Lee, col. 2, ll. 39-47). It follows that the wafer is not exposed to air in the chamber and the gas environment is carefully controlled.

With this in mind, we turn to Figure 5, the Figure graphically illustrating Lee's inventive process. Figure 5 shows graphically that no gas is input into the chamber during start-up and heat treatment. The pressure graph (top line) shows the pressure increase that corresponds to the gas ramp-up/ramp-down of the in-situ pre-cleaning step that is the focus of the invention of Lee. The Si_2H_6 gas graph (third from the bottom) shows that the Si_2H_6 gas is ramped-up during the second venting step, maintained during seeding, and ramped-down at the beginning of the heat treatment

process. While the pressure graph of Figure 5 depicts only the pressure during the pre-cleaning step, one of ordinary skill in the art would understand that another pressure increase corresponding to the seed layer step would also occur in the process just as it would in the prior art process of Figure 3. That the Si_2H_6 gas is removed and the pressure lowered to a higher vacuum state at the beginning of the heat treatment step is evident from the Si_2H_6 gas graph of Figures 3 and 5. That the heat treatment is conducted in a vacuum environment would be evident to one of ordinary skill in the art reading Lee.

Appellants' alternative interpretation of Lee does not convince us that the Examiner's interpretation is unsupported. According to Appellants, "a logical interpretation of the overall disclosure of the Lee reference is that a vacuum level of 10^{-3} - 10^{-4} Torr is present in the chamber during the 'In-situ Pre-cleaning' step, and this vacuum is removed after the 'In-situ Pre-cleaning' step." (Brief, p. 11). This is, according to Appellants, because "the ramp-up/ramp-down graph lines for the 'pressure' quantity shown in Fig. 5 were merely intended to convey the idea of a non-zero quantity for the pressure characteristic, rather than provide any clear indication regarding what the pressure level is immediately prior to, or after, the 'In-situ Pre-cleaning' step." (*Id.*). This interpretation ignores the context of the teaching of Lee. The process is concerned with manipulating silicon on a molecular level, a process susceptible to contamination. The reference discusses ventilation of gases at low

pressures of 10^{-3} to 10^{-4} Torr. The graphs show pressure reductions consistent with the ventilation teachings. The Examiner's interpretation is reasonable.

A preponderance of the evidence supports the finding of the Examiner that Lee would teach one of ordinary skill in the art to perform the heat treatment in a low pressure environment.

Appellants further argue that Choi does not disclose performing a heat treatment in a vacuum (Brief, p. 13). In so arguing, Appellants reproduce a passage from Choi to support their position that Choi merely discloses that the etching step is performed in a vacuum and does not additionally heat treat in a vacuum. But the reproduced passage is not contrary to the Examiner's interpretation of the reference. Rather, what is made clear by the passage is that, as acknowledged by Appellants, the etching step is performed in a vacuum or low pressure environment. The passage also makes clear that it is preferable to heat the process chamber prior to etching. The portion of the last sentence not reproduced by Appellants also makes it clear that this heating is performed so as to obtain a desirable etch rate (Choi, col. 5, ll. 27-31). Both the heating and the etching are conducted within the process chamber and are intended to be conducted in conjunction with each other. There is no intervening disclosure of changing the state of vacuum between the step of heating and the step of etching. The disclosure of Choi as a whole would have suggest to one of ordinary skill in the art that both the heating and etching steps of Choi are to be conducted under vacuum

conditions. The Examiner's interpretation of Choi is reasonable and supported by a preponderance of the evidence.

We, therefore, conclude that the totality of the evidence supports the Examiner's conclusion of obviousness with respect to the subject matter of claim 31.

Before turning to claim 33, we focus on claim 35. This claim was rejected over the same prior art as claim 31 and one additional prior art reference: Farnworth. The Examiner finds all the limitations in the prior art and advances a reason for making the combination (Answer, p. 4) as is required to establish a prima facie case of obviousness. Appellants do not dispute any of the additional findings of fact or conclusions of law presented in this rejection, rather, Appellants again focus on the limitations of claim 31 and repeat the arguments we have addressed above. For the reasons discussed above, we conclude that the Examiner has established a prima facie case of obviousness with respect to the subject matter of claim 35 which has not been sufficiently rebutted by Appellants.

Turning to claim 33, Appellants argue that neither Lee nor Choi discloses heat treating in a vacuum lock chamber as required by claim 33 (Brief, p. 15). According to Appellants, the only vacuum applied in the processes of Lee and Choi occurs in the process chamber, not in a vacuum lock chamber (Brief, p. 15). The Examiner makes the statement in the rejection that "both Lee and Choi disclose that the heat treatment is accomplished in a vacuum lock chamber." (Answer, p. 4). The Examiner cites to no

portion of either reference supporting the finding. Nor does the Examiner respond to Appellants' argument.

Looking to Lee and Choi, we can find no apparent support for the finding of the Examiner. Claim 33 requires at least one of the heat treatments of claim 31 take place in a "vacuum lock chamber." As argued by Appellants, in the processes of Lee and Choi, heating takes place in the processing chamber. The question then becomes: What is the meaning of "vacuum lock chamber"? Turning to the specification, we note that heating is discussed as taking place in a "loading device" or "load lock". In Appellants' process, the first heat treatment occurs in a "loading device" or "load lock" which is pumped out to create a vacuum (specification, p. 9), the wafer is moved to a reaction chamber wherein etching occurs (specification, p. 10), and then the wafer is discharged back to the "load lock" wherein further heating under vacuum conditions occurs (specification, p. 12). We note that Choi describes that a "loadlock chamber 12 is installed below the process chamber." (Choi, col. 4, ll. 32-33). The evidence indicates that "lock chamber" is a term of art referring to a chamber separate from the processing or reaction chamber. Neither Lee nor Choi describe heating occurring in a "vacuum lock chamber," in both cases heating occurs in a process chamber.

We conclude that the Examiner has failed to establish a prima facie case of obviousness with respect to the subject matter of claim 33.

CONCLUSION

To summarize, we sustain the rejection of claims 31 and 35, but do not sustain the rejection of claim 33, therefore, the decision of the Examiner to reject claims 31, 33, and 35 under 35 U.S.C. § 103(a) is AFFIRMED-IN-PART.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

BRADLEY R. GARRIS
Administrative Patent Judge

TERRY J. OWENS
Administrative Patent Judge

CATHERINE TIMM
Administrative Patent Judge

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